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DEFENSE METALS INFORMATION CENTER

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Compiled by:

Patricia B. Plate

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HIGH-STRENGTH ALLOYS

50214 EVALUATION OF BROACHING AND SIZING HUCKBOLTS. R. R. Wilcox, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report 9328, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(36 pages, 26 figures, 3 tables)

The purpose of this investigation was to determine the tensile, fatigue, static, and metallurgical properties of newly-developed broaching and sizing Huckbolts, and to compare these properties with those of the presently used NAS and conventional Huckbolts.

50234 See Miscellaneous.

50282 THERMAL STRESSES AND DEFLECTIONS IN RECTANGULAR PANELS PART I. M. J. Forray, M. Newman, and J. Kossar, Republic Aviation Corporation, Farmingdale, Long Island, New York. ASD TR 61-537, Part I, Final Report, December, 1962, Contract No. AF 33(616)-7751
(5 references, 73 pages, 27 figures)

The problem of a rectangular plate subjected to both linear and nonlinear temperature gradients through the thickness, with no planform variation, is analyzed for a variety of edge-support conditions. Numerical evaluation of derived formulae for the deflections and bending moments are given in the form of non-dimensional curves for various aspect ratios and edge supports.

Test results for glass plates are presented which are in good agreement with the calculated deflections for two aspect ratios and two edge conditions. Experimental difficulties prevented satisfactory verification of predicted strains.

50307 DYNAMIC BUCKLING OF SHELL STRUCTURES SUBJECT TO LONGITUDINAL IMPACT. A. P. Coppa, and W. A. Nash, General Electric Company, Philadelphia, Pennsylvania. ASD TDR 62-774, Final Report, December, 1962, Contract No. AF 33(616)-8248
(16 references, 77 pages, 45 figures)

50307 (Continued)

Investigations dealing with the buckling of thin cylindrical and conical shells subject to axial impact are described. The studies consisted of experimental and theoretical efforts directed toward obtaining a qualitative and quantitative understanding of the dynamic buckling behavior of such shells under a variety of conditions. The conditions studied include different longitudinal conditions imposed on the impacted end of the shell and internal pressurization. In addition, methods of increasing the specific-energy-dissipation capacity of shells subject to axial impact were studied.

50368 AIR WEAPONS MATERIALS APPLICATION HANDBOOK METALS AND ALLOYS. V. Weiss, R. V. Jelinek, J. G. Sessler, B. A. Wasil, J. V. Latorre, and R. D. Ziemer, Syracuse University, Syracuse, New York. ASD, ARDC-TR-59-66, August, 1962, Contract No. AF 33(616)-7792 (numerous references, numerous pages, numerous figures, numerous tables)

The first edition of the Air Weapons Materials Application Handbook, Metals and Alloys, attempted to assemble pertinent and up-to-date information on the properties of the alloys of primary importance for the design and production of air weapons.

The present Supplement to the first edition contains the data on 40 additional alloys: 17 ferrous, 8 nonferrous, and 15 high-temperature alloys with particular emphasis on refractory metals and alloys.

50524 HIGH-TEMPERATURE MATERIALS PROGRAM. General Electric Company, Cincinnati, Ohio. AEC, GEMP-9A, Progress Report No. 9, Part A, March 30, 1962, Contract No. AT(40-1)-2847 (71 pages, numerous figures, numerous tables)

Included in this report is a summary of the work of the eighteen specific development programs in process.

The topics covered are: (1) Metallic fuel element materials for greater than 1200 C operation in oxidizing atmospheres, (2) High-temperature control materials, (3) Fabricability of high-temperature structural materials, (4) High-temperature alloys, (5) Moderator fabrication and testing, and (6) High-temperature insulation materials.

50525 HIGH-TEMPERATURE MATERIALS PROGRAM. General Electric Company, Cincinnati, Ohio. AEC, GEMP-13A, Progress Report No. 13, Part A, July 31, 1962, Contract No. AT(40-1)-2847 (65 pages, numerous figures, numerous tables)

This report is the unclassified portion of the thirteenth in a series of monthly reports of the work in process on materials development.

Included is a summary of the work from April 15, 1962, to June 15, 1962, on six of the eighteen specific development programs in process.

The topics covered are the same as those covered in the ninth progress report (DMIC 50524).

Cobalt Base

50544 FIBER REINFORCEMENT OF METALLIC AND NONMETALLIC COMPOSITES. R. H. Baskey, Clevite Corporation, Cleveland, Ohio. ASD, ASD TR-7-924(IV), Interim Technical Engineering Report, December 27, 1962, Contract No. AF 33(657)-7139
(2 references, 28 pages, 7 tables)

The objective of this program is to establish parameters for the selection and application of fibers to the reinforcement of metal matrices and to demonstrate that this can be achieved through the fabrication of sheet and forged products.

The elevated-temperature (2000 F) short-time tensile strength of cobalt was increased from 2,700 psi to 23,700 psi by reinforcing the cobalt with 18 volume per cent of 5 mil continuous tungsten wires. This strengthening by 5 mil wires was equivalent to 89 per cent of theoretical strengthening and was comparable to that attained by using the same quantity of 10 mil tungsten wire.

Nickel Base

50204 ELEVATED TEMPERATURE TENSILE PROPERTIES OF INCONEL 625 NICKEL CHROMIUM ALLOY. J. Huebner, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report No. 9338, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(27 pages, 27 figures, 2 tables)

Inconel 625 is a new nickel-base alloy that requires no aging. This test was conducted to determine the room- and elevated-temperature tensile properties and fabrication characteristics of Inconel Alloy 625 sheet.

The material was evaluated in the cold rolled, annealed, and pickled condition. The mechanical properties were evaluated at room temperature, 1000 F, 1400 F and 1600 F. The minimum bend radius was determined at room temperature.

The tensile strength of the alloy decreased from Ftu 135 Ksi, Fty 66 Ksi at room temperature to Ftu 45 Ksi, Fty 36 Ksi at 1600 F.

The per cent elongation remained constant up to 1000 F (50 per cent) and decreased to approximately 30 per cent at 1400 F exhibiting intergranular fracture. At 1600 F elongation of the alloy again appears to increase.

50205 EXAMINATION OF ELECTRON BEAM WELD SAMPLES OF INCONEL X. J. P. O'Connor, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report No. 9336, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(30 pages, 28 figures)

Two tensile specimens were tested. One was tested in the "as welded" condition and failed in the weld. Recorded data are Fty, 83,000 psi; Ftu, 123,000 psi; and 12.5 per cent elongation. The other specimen was annealed, stress equalized, and age hardened to Rc 32-40 subsequent to welding. It failed in the base metal. Recorded data are: Fty, 122,000 psi; Ftu, 164,500 psi; and elongation 22 per cent. Strengths correspond favorably to values published by the manufacturer.

Test results indicate that Inconel X responds well to electron-beam welding techniques. Narrow but deep fusion zones can be obtained with a minimal effect on the material characteristics of the workpiece.

50206 INITIAL EVALUATION OF BRAZEABILITY OF INCONEL 718 NICKEL CHROMIUM ALLOY. F. J. Coffey, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report No. 9337, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(30 pages, 19 figures, 2 tables)

A preliminary test was conducted to investigate the feasibility of brazing Inconel 718 with various braze alloys. The braze alloy - Inconel 718 specimens were evaluated by a series of wetting tests.

Flat Inconel 718 specimens were vacuum brazed with three nickel-base and three silver-base braze alloys at pressures of 3×10^{-4} to 5×10^{-4} mm Hg. The flow radius and wetted area were measured, and the specimens were sectioned for metallographic determination of the solidified contact angle between the braze alloy surface and the base metal.

50206 (Continued)

Within the scope of these tests, the nickel-base braze alloys exhibited superior wetting and flow characteristics to silver-base braze alloys when applied to Inconel 718.

50215 DEVELOPMENT AND MEASUREMENT OF EMISSIVITY PROPERTIES OF LOW EMISSIVITY MATERIALS. E. Malakelin, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report 9352, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(45 pages, 27 figures, 1 table)

This development and measuring program was initiated because information was lacking regarding surface preparation, life of coatings at various temperatures, and emissivity values of materials applicable to MAC processings.

50543 THE THERMODYNAMIC PROPERTIES OF α, F. C. C., NICKEL - ZINC ALLOYS. E. V. Clougherty and L. Kaufman, ManLabs, Inc., Cambridge, Massachusetts. Office of Naval Research, Technical Report No. 6, February 1, 1963, Contract No. Nonr 2600(00)
(18 references, 28 pages, 3 figures, 7 tables)

The thermodynamic properties of solid nickel-zinc alloys in the α face-centered-cubic, phase were obtained from vapor-pressure data measured by the dew-point method in the range 900 to 1100 C. The measured negative excess entropy of the α phase at high temperatures is discussed in terms of the calculated magnetic entropy based on saturation-magnetization data for the alloys, and the vibrational entropy based on Debye temperatures from temperature-dependent-X-ray-intensity data. The specific heat of three face-centered-cubic alloys was measured from 1.4 to 4.0 K. Some limitations of the electronic specific coefficient, γ, and the Debye temperatures derived from the latter measurements are presented.

Engineering Steels

50210 INVESTIGATION OF HYDROGEN EMBRITTLEMENT OF HARD HIGH CHROMIUM ALLOY PLATED 4340 STEEL. J. Krieg, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report No. 9331, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(20 pages, 7 figures, 4 tables)

The present processes of chromium plating have been limited to steels heat treated below 200 ksi. The purpose of this investigation is to determine the effects of a hard high-chromium-alloy plating process as applied to 4340 steel heat treated to the 220-240 ksi range, and to certify three vendors capable of employing this process.

On the basis of the test results, the application of hard high-chromium-alloy platings by the three vendors mentioned in this report to 4340 steel heat treated to the 220-240 ksi range results in serious embrittlement of the steel. However, a subsequent 24-hour stress-relieving operation at 375 F is sufficient to restore the steel to its former, unplated condition.

50240 THREAD ROLLING OF LOW STRENGTH AND ULTRA HIGH STRENGTH STEELS. R. H. Brookes, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report 9350, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(26 pages, 9 figures, 7 tables)

MAC has obtained a Lanhyrol Model 24 FW Thread Rolling Machine from the Landis Machine Company. This test was conducted to determine if bolts manufactured using the Lanhyrol Model 24 FW meet the pertinent test requirements of MIL-B-7838 and NAS 496 and to determine the effects of processing variables on the ability of the bolts to meet these specifications.

Testing consisted of determining the thread form, tensile strength, fatigue properties, and sustained-load characteristics of bolts in both the as-received condition and after rolling new threads with the Lanhyrol machine.

50343 MOTOR CASE FABRICATION TECHNIQUES AND APPLICATIONS. D. C. Sayles, United States Army Missile Command, Redstone Arsenal, Alabama. Report No. RK-TR-62-5, October 18, 1962
(8 references, 13 pages, 4 tables)

The purpose of this paper is to consider the present development status and outlook for solid-propellant motor-case fabrication techniques and applications within the United States. This review will include a consideration of all of the motor-case development programs which are being conducted under the sponsorship of the Ordnance Materials Research Office and certain missile development programs.

50427 DIRECT CONTACT EXPLOSIVES METALFORMING. J. Savitt, Explosiform, Inc., Park Forest, Illinois. ASD-TDR-62-1035, Final Technical Documentary Report, October, 1962, Contract No. AF 33(657)-9631
(3 references, 11 pages, 41 figures)

50427 (Continued)

The technical foundation of employing high explosives in direct contact with metal workpieces for non-destructive metal forming was investigated. Low-density Nitroguanidine and low-density Tetryl charges were detonated in direct contact with mild steel workpieces in simple plate and tube bulging experiments. Plates and tubes were successfully bulged without significant surface damage by direct contact detonation of Nitroguanidine explosives charges which varied in density from about 0.1 to about 0.5 g/cc. Tetryl charges at a density of 0.88 g/cc (the lowest density obtainable) caused serious surface pitting and spalling when detonated in direct contact with the workpiece. Successful bulges from 1 1/2 to 18 inches in diameter were obtained without significant contact surface damage with mild steel plates ranging in thickness from 1/16 to 5/8 inch. The practical foundation of direct-contact low-density low-detonation-pressure detonating high-explosive metal forming was conclusively established. Quantitative effects of explosives weight and density upon direct-contact plate and tube bulging were determined for Nitroguanidine explosives charges and mild steel workpieces.

50563 STUDIES OF DESIGN CRITERIA FOR WELDED STRUCTURES SUBJECTED TO A BIAXIAL STRESS FIELD. B. L. Baird, Bruce L. Baird, Inc., Wilmington, California. ASD, ASD-TDR-62-1109, Technical Documentary Report, January, 1963, Contract No. AF 33(657)-8595
(14 references, 86 pages, 22 figures, 14 tables)

Parent and weld metal biaxial stress-strain data were obtained in a 2:1 tension-tension stress field from 4 steels and 1 titanium alloy at 3 test temperatures. Steels were oil hardening, air hardening, and precipitation hardening types. Titanium was all-beta alloy. Honed and ground tubular specimens containing 2 longitudinal seam welds were tested using strain-gage rosettes attached in both weld and parent-metal zones to develop biaxial stress-strain relationships. Values of fabrication stress-concentration factors were obtained from burst testing welded vessels made from the test materials. Use of the biaxial stress-strain data in combination with fabrication stress-concentration factor values in the design of high strength pressure vessels is illustrated at the end of the text.

50572 FRACTURE SURFACE CONFIGURATIONS OF AISI 4340 STEEL AS EFFECTED BY TEMPERATURE AND GEOMETRY. F. L. Carr and F. R. Larson, Watertown Arsenal Laboratories, Watertown, Massachusetts. WAL TR 320.1/10, Technical Report, January, 1963
(11 references, 28 pages, 10 figures, 4 tables)

Measurements of the different zones of fracture configurations were made on both smooth- and notched-tensile specimens in addition to Charpy specimens of AISI 4340 steel heat treated to three strength levels and tested over a range of temperatures (-196 to 200 C). These measurements plotted as a function of temperature result in transition curves due to the different modes of fracturing. The differences in both the locus of the origin and direction of propagation of fracture

50572 (Continued)

between the smooth- and notched-tensile specimens are discussed and illustrated. Similarities in the fracture configurations of both tensile and Charpy specimens are also described and illustrated. The importance of these fracture zones and their influence on the notch-strength ratio are discussed.

Stainless Steels

50201 DETERMINATION OF MINIMUM BEND RADIUS FOR 5/32 INCH THICK SPACEMETAL. R. H. Brookes, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report No. 9332, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(23 pages, 3 tables, 10 figures)

Spacemetal is a stainless steel corrugated assembly in flat sheet form. The spacemetal manufacturing process involves the attachment of the face sheets to either side of the corrugation simultaneously, at a very rapid rate by resistance welding.

Since spacemetal is a relatively new type structure, forming techniques must be devised if it is to have practical application. This test was performed to obtain some basic data concerning stretch forming the material.

Minimum bend radii were determined for various spacemetal test configurations which included (a) unfilled specimens, (b) specimens filled with Cerrobend 158, and (c) filled specimens with an aluminum doubler bonded to the face sheet in tension during bend test. Tests were conducted at room temperature and -40 F.

50215 See Nickel Base.

50239 DETERMINATION OF THE CORROSIVE EFFECTS OF PRESSURE SENSITIVE TAPES ON STAINLESS STEEL HOT AIR DUCTS. H. W. Jacobus, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report 9361, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(19 pages, 24 figures)

Four types of pressure-sensitive tapes, Polyken 290, 292, Mystik 7000, and Permacel 211 were applied to two types of stainless steel, 19-9 DL and 321. The specimens were subjected to a heating cycle of 500 F for one hour and a relative humidity of 95 per cent at 90 F for 20 hours for 24 cycles.

The adhesive on the Polyken 290 tape charred after the first cycle and embrittled the tape. The other tapes showed fair to good adhesive qualities upon completion of the test. There was no indication corrosion resulted from any of the four tapes contacting the stainless steel.

50241 EVALUATION OF ANTI-SEIZE COMPOUNDS IN THREADED CONNECTIONS. J. Huebner, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report 9363, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(30 pages, 24 figures, 7 tables)

Earlier investigations determined the metallurgical effects of various anti-seize compounds on high-temperature alloys. From that study several anti-seize compounds were selected to be tested in threaded connections. The compounds selected were tested near their maximum temperature limit with the alloy most likely to be used for fasteners.

The test bolts were coated, torqued to 190 inch-pounds and baked for three hours. The loosening, breakaway, and running torques of each bolt were determined. The cycle was repeated without additional lubricant.

50241 (Continued)

A-286 plates and self-locking plate nuts were used as the fastener up to 1200 F, and Rene' 41 threaded blocks were used from 1500 F to 1800 F. Bare bolts were also tested at each temperature.

50303 See Titanium.

50342 FLAT HIGH STRENGTH STEEL SHEET APPLICABLE FOR USE IN THE AIRCRAFT AND MISSILE INDUSTRY. T. H. McCunn and B. Sack, Allegheny Ludlum Steel Corporation, Brackenridge, Pennsylvania. ASD TR 62-7-780, Final Technical Engineering Report, August, 1962, Contract No. AF 33(600)-40312
(29 pages, 5 figures, 175 tables)

This manufacturing process development improved and evaluated hot- and cold-rolling techniques in the production of 36- and 48-inch wide coiled sheet of air-frame structural materials of 1/4 of AISI thickness tolerances. The results of this program demonstrated the adequacy of conventional steel mill equipment and controlled processing to provide materials such as semi-austenitic PH steels, martensitic alloy steels, martensitic stainless steels, hot-work die steels, and austenitic PH steels to meet aircraft quality steel specifications.

This report describes work conducted at Allegheny Ludlum Steel Corporation wherein a total of 35 coils of A-286, AM-350, Potomac A, Type 422, and Altemp R-41 were processed to finished thicknesses of 0.010 inch, 0.030 inch, 0.080 inch, and 0.100 inch. Coils were gaged at hot-roll, intermediate, and finished thickness. Although all coils are not within the desired thickness range, it has been demonstrated that all material with the possible exception of Altemp R-41 can be produced to 1/4 AISI thickness tolerance on the available equipment. It was shown that the most important factor affecting crown at finish gage is the per cent crown at hot-roll thickness.

50437 BOUNDARY LUBRICATION CHARACTERISTICS OF A TYPICAL BEARING STEEL IN LIQUID OXYGEN. W. F. Hady, G. P. Allen, R. L. Johnson, Lewis Research Center, Cleveland, Ohio. NASA TN D-1580, Technical Note, February, 1963
(10 references, 15 pages, 7 figures)

Experiments were conducted in liquid oxygen to establish the fundamental boundary-lubrication characteristics of liquid oxygen and to study the wear and friction mechanisms experienced by a metal-metal combination. A 3/16-inch-radius hemispherical rider was loaded against the flat surface of a 2.5-inch-diameter rotating disk. Both rider and disk materials were AISI 440-C chromium martensitic stainless steel heat treated to a Rockwell C hardness of 52 to 54. The loads were varied from 200 to 1500 grams and the sliding velocities from 250 to 8000 feet per minute.

These data demonstrate the boundary-lubrication characteristics of a typical bearing material utilizing liquid oxygen as the lubricant. The results indicate that liquid oxygen is potentially a better lubricant than liquid hydrogen, because surface-reaction films that form in liquid oxygen can provide adequate protection of metal surfaces in sliding contact. The results also indicate that the adhesion concept of friction and wear derived from more conventional applications is valid for liquid-oxygen applications.

50563 See Engineering Steels.

LIGHT METALS

50234 See Miscellaneous.

50265 See Titanium.

50368 See High Strength Alloys.

50421 A PARAMETRIC STUDY OF THE HYPERVELOCITY PERFORATION OF VISCO-PLASTIC PLATES. P. C. Chou, R. W. Mortimer, and R. E. Llorens, Drexel Institute of Technology, Philadelphia, Pennsylvania. Ballistic Research Laboratories, DIT 125-3, January, 1963, Contract No. DA-36-034-ORD-3672 RD
(5 references, 29 pages, 13 figures, 1 table)

This report presents additional theoretical results based on a visco-plastic flow model for hypervelocity perforation of thin plates. The solutions of the governing equations including the yield strength are obtained. The results of a parametric study performed on an IBM 1620 computer are also included. The effects on the radius of perforation due to various physical quantities are discussed. The theoretical radius of perforation and residual velocity are compared with the experimental values obtained by R. W. Watson.

Beryllium

50432 DEVELOPMENT OF FINE DIAMETER HIGH-PURITY WIRE FROM ZONE-REFINED BERYLLIUM. A. G. Gross, Jr., and R. G. O'Rourke, The Brush Beryllium Company, Cleveland, Ohio. Bureau of Naval Weapons, TR No. 298-236, Final Report, December, 1962, Contract No. NOw 62-0067-c
(15 references, 54 pages, 19 figures, 5 tables)

Zone-refined crystals of both thermally- and electrolytically-reduced beryllium were converted to polycrystalline aggregates by a combination of deformation and heat treatment. The resulting polycrystalline aggregates were subjected to deformation at 450 C by standard beryllium wire-drawing techniques. A limited amount of metallurgical evaluation of the resulting wire was accomplished.

It was found that combination of twinning and primary recrystallization was required to convert the single crystal to a truly polycrystalline aggregate.

The wire produced from zone-refined beryllium exhibited usable structural tensile properties at room temperature.

50449 STRESS RELIEVING OF BERYLLIUM. C. H. Thibault, Lockheed Missiles and Space Company, Sunnyvale, California. Manufacturing Process Standards, MPS 6.11, November 15, 1962
(4 pages)

The process described in this standard is for stress relieving beryllium as specified on the engineering drawing.

Titanium

50203 EFFECT OF HOT FORMING ON THE AGED TENSILE PROPERTIES OF TITANIUM ALLOY TI-13V-11CR-3AL (B120VCA). J. Sveitis, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report No. 9334, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(11 pages, 2 figures, 2 tables)

Mechanical property tests were conducted to compare the Fty, Ftu, and per cent elongation of specimens taken from B120VCA test panels that had been: (a) rubber formed and aged, (b) rubber formed and creep formed, (c) rubber formed, creep formed, and aged.

Test results revealed that the Ftu, Fty, and per cent elongation of rubber formed and creep formed panels approximated values for solution treated material and that the values for rubber formed and aged, and rubber formed, creep formed, and aged approximate those of aged material. Apparently creep forming after rubber forming does not have a marked effect on mechanical properties.

50207 THE PROTECTION OF TITANIUM FROM HYDROGEN EMBRITTLEMENT DURING PICKLING (TI-13V-11CR-3AL). E. Schonboun, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report No. 9335, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(2 references, 18 pages, 3 figures, 2 tables)

The control of hydrogen pickup by titanium in two common pickling solutions was investigated. Test specimens of Ti-13V-11Cr-3Al, all cut from one stock sheet, receiving identical preliminary treatments were pickled under strictly controlled conditions.

An attempt was made to reduce the amount of hydrogen pickup by attaching to the titanium a metal which is more electro-negative than itself, namely, platinum; and by imposing a DC current to the titanium making it anodic. Little or no improvement accompanied the platinum attached specimens in either solution.

50265 EFFECTS OF SPUTTERING WITH HYDROGEN IONS ON TOTAL HEMISPHERICAL EMITTANCE OF SEVERAL METALLIC SURFACES. D. L. Anderson, G. J. Nothwang, Ames Research Center, Moffett Field, California. NASA TN D-1646, January, 1963
(17 references, 36 pages, 13 figures, 2 tables)

The test specimens were cylindrical and were constructed from pure titanium, a titanium alloy containing 6 per cent aluminum and 4 per cent vanadium, pure aluminum, 2024 aluminum alloy, and pure copper. The energy level of the incident ions was 1000 electron volts. The test specimens were subjected to ion bombardment by immersion in a hydrogen plasma. The total hemispherical emittance of each specimen was measured in a cold-wall vacuum-type calorimeter. Photomicrographs of all test specimens before and after bombardment with 10^{21} ions/cm^2 are presented and discussed. In addition, the changes in weight resulting from ion bombardment of all specimens are presented.

50276 ELECTROLYTIC METHODS OF PREPARING CELL FEED FOR ELECTROREFINING TITANIUM. M. M. Wong, R. E. Campbell, D. C. Fleck, and D. H. Baker, Jr., United States Department of the Interior, Bureau of Mines, Washington, D. C., RI 6161, 1963
(22 pages, 5 figures, 11 tables)

Electrolysis of titanium carbide and a material consisting of titanium, carbon, nitrogen, and oxygen as soluble anodes in fused electrolytes was investigated by the Bureau of Mines for the preparation of crude titanium metal. Tests made in all-chloride electrolytes showed only a low recovery of titanium as well as a substantial volatilization of titanium trichloride ($TiCl_3$) when present in the electrolyte.

Electrolysis at 750 to 850 C in a mixture containing 85 per cent NaCl-15 per cent potassium flurotitanate (K_2TiF_6) yielded as high as 91 per cent recovery of titanium from titanium carbide and 62 per cent recovery of titanium from the titanium-carbon-nitrogen-oxygen material. Problems associated with the preparation of crude metal by fused-salt electrolysis are discussed. The crude metals produced from both anode materials were electrorefined in a sodium-chloride-titanium-chloride ($NaCl-TiCl_2$) electrolyte, and ductile titanium metal was obtained.

50303 REACTIVITY OF METALS WITH LIQUID AND GASEOUS OXYGEN (PREPRINT OF DMIC REPORT). J. D. Jackson, W. K. Boyd, and P. D. Miller, Battelle Memorial Institute, Columbus, Ohio. Defense Metals Information Center Memorandum No. 163

Of all the metals studied to date, titanium exhibits the greatest sensitivity to impact when immersed in LOX. Titanium can be partially protected from reactivity in LOX under impact by certain protective coatings, provided the coatings are not broken. Protection is given by electroless copper and nickel, possibly aluminum, and to a lesser extent by Teflon and a fluoride-phosphate coating. Protection is also obtained by nitriding which adds a protective film to the surface, and by annealing which increases the thickness of the oxide film.

In gaseous oxygen, titanium is highly reactive when a freshly formed surface is exposed at even moderate pressures. Under conditions of tensile rupture, a pressure of about 100 psig will initiate a violent burning reaction with titanium from about -250 F up to room temperature.

Of other metals discussed, only zirconium shows similar reactions in oxygen. Stainless steels are found to exhibit almost no reactivity in oxygen under impact, rupture, explosive shock, or heating. Aluminum is similarly unreactive, but will ignite under conditions of high-explosive shock. Magnesium shows reactivity to explosive shock lying about midway between that of aluminum and titanium.

50343 See Engineering Steels.

50423 CRACK INITIATION IN METALLIC MATERIALS. V. Weiss, K. Schroder, P. Packman, and J. G. Sessler, Syracuse University Research Institute, Syracuse, New York. Bureau of Naval Weapons, MET 878-6211-F, Final Report, November, 1962, Contract No. NOw-61-0710-d (21 references, 34 pages, 11 figures, 4 tables)

The present program consisted of an investigation of the conditions for crack initiation as a function of the test specimen geometry, the test material, the testing conditions and the internal structure of the material. Tungsten and titanium sheet specimens were selected for the studies. Lithium fluoride and silver chloride were utilized to yield information concerning the dislocation motion and arrangement at and near existing cracks.

The experimental results obtained to date are presented and discussed in this report, which summarizes the results of the first year's effort. These results include the study of the effects of recrystallization on the fracture strength of notched tungsten specimens, of the surface condition of smooth and notched titanium and tungsten specimens as well as a description of the dislocation arrangements in lithium fluoride single crystals near existing cracks. Tensile and notch-tensile specimens containing both machined as well as fatigue-cracked notches were utilized. Selected tungsten and titanium specimens were tested after the surface had been electropolished and the notch root had been prepared by electrolytical machining.

50563 See Engineering Steels.

Magnesium

50199 DETERMINATION OF OPTIMUM FORMING TEMPERATURES AND MECHANICAL PROPERTIES OF HM21A-T81 MAGNESIUM WELDED WITH EZ33 FILLER METAL. R. J. Meyer, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report No. 9329, Final Report, January 10, 1963, Contract No. AF 33(657)-7749 (42 pages, 12 figures, 22 tables)

During attempts to bulge form HM21A-T81 magnesium sheet welded with EZ33 filler metal, trouble has been encountered due to local thinning in the base metal and cracking in welds. In order to overcome this, mechanical property testing, which had previously been conducted from 350 to 600 F, was continued from 600 to 750 F. Reduction of area tests were performed through a temperature range of 400 to 750 F, on specimens strained to a permanent elongation of 7 per cent, or to failure.

Data obtained from these tests indicate that reduction of area is much more uniform at temperatures between 725 F and 750 F than at lower test temperatures. Weld efficiency at 750 F approaches that of base metal. For these reasons, local thinning of base metal and cracking in welds should be much less prominent when bulge forming is conducted in the temperature range from 725 to 750 F.

50200 EVALUATION OF CORROSION RESISTANCE OF DOW 17 AND HAE COATINGS. J. S. Swafford, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report No. 9330, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(11 pages, 2 tables)

This test was initiated to determine the corrosion resistance of Dow 17 coatings Type II and III with certified thicknesses.

The specimens were exposed to a 20 per cent salt-spray environment complying with Federal Test Standard No. 151, Method 811.1.

Test results revealed that Dow 17 generally affords good protection to magnesium alloys; however, all test specimens did exhibit signs of attack in a 48 hour period.

50303 See Titanium.

NONMETALLICS

50234 See Miscellaneous.

50576 NONDESTRUCTIVE ANALYSIS OF THE BRITTLE FRACTURE BEHAVIOR OF CERAMIC MATERIALS. G. G. Paulson, J. H. Lauchner, C. Scott, and G. E. Weeks, Mississippi State University, State College, Mississippi. ASD, ASD-TR-61-436, Part II, Technical Documentary Report, November, 1962, Contract No. AF 33(616)-7347
(33 references, 57 pages, 18 figures, 7 tables)

The work effort under this project was divided into three areas. The first was devoted to an experimental analysis of the possibility of applying certain physical principles toward development of a nondestructive test for brittle materials. In this work, a technique called "diffusion doping" was studied as a possible tool to aid in analyzing brittle fracture.

In Part Two the work was of a theoretical nature. A one-dimensional heat-conduction problem was solved by the LaPlace transformation method. The problem consisted of a symmetrical composite body of five slabs that was moved suddenly from one temperature environment at equilibrium to a second temperature environment. Constant thermal properties and constant surface coefficients were utilized, and equations that express the temperature as a function of time and position were presented.

In Part Three relations were derived for thermal stresses set up under the conditions described in Part Two. No numerical answers were given, but the general systems of derived equations were utilized in indicating how the desired solutions could be obtained by digital computer techniques.

Carbon, Graphite

50550 STRUCTURAL TRANSFORMATION IN PYROLYTIC GRAPHITE ACCOMPANYING DEFORMATION. W. V. Kotlensky and H. E. Martens, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California. NASA, 32-360, Technical Report, November 1, 1962, Contract No. NAS 7-100
(20 references, 11 pages, 6 figures, 1 table)

This report presents the structural transformation in one lot of pyrolytic graphite after heating to 3000 C and after various amounts of deformation at 2760 C. Transformation was followed by crystallographic and preferred-orientation measurements and by electron-microscope examination of the basal plane surfaces and edges of the graphite.

Special Refractories

50277 LITERATURE SURVEY ON SYNTHESIS, PROPERTIES, AND APPLICATIONS OF SELECTED BORIDE COMPOUNDS. B. R. Emrich, Directorate of Materials and Processes, Wright-Patterson Air Force Base, Ohio. ASD TDR 62-873, Final Report, December, 1962
(107 references, 77 pages, 20 figures, 58 tables)

A comprehensive review of the literature was made to assist in providing background information needed for future work concerning boride materials. The materials reviewed included solid bodies of TiB_2, ZrB_2, HfB_2, VB_2, NbB_2, TaB_2, CrB_2, and ThB_4. This compilation presents information on synthesis, properties, and applications of the selected boride compounds, including selected abstracts and articles.

This documentary search, by showing many gaps and wide scatter where information is available, demonstrates the need for the development of authoritative scientific information on borides applicable to future technological requirements.

50523 DEVELOPMENT AND UTILIZATION OF OPTIMUM TECHNIQUES FOR THE FABRICATION OF TITANIUM BORONITRIDE ROCKET NOZZLES. R. Strickman and J. Donnellon, Calorobic Materials, Inc., Pearl River, New York. TR 371-9/4, First Quarterly Report, October, 1962, Contract No. DA-30-069-ORD-3747
(23 pages, 5 figures, 2 tables)

This report summarizes the work completed on the preparation and initial development techniques for the fabrication of titanium-diboride, titanium-nitride, boron-nitride rocket-nozzle inserts and other test specimens. Design of machinery, equipment and tooling required to produce the various parts has been initiated. In the fabrication of test parts, the need of new machining techniques and non-destructive-parts inspection before and after machining was evident.

Ceramic Oxide

50306 THE ROLE OF THE GRAIN BOUNDARY IN THE DEFORMATION OF CERAMIC MATERIALS. G. T. Murray, J. Silgailis, and A. J. Mountvala, Materials Research Corporation, Orangeburg, New York. ASD TDR 62-225, Summary Report, December, 1962, Contract No. AF 33(616)-7961 (9 references, 34 pages, 18 figures, 1 table)

The grain boundaries of MgO bicrystal specimens were subjected to creep-rupture tests in the temperature range of 1300-1500 C and at shear stresses varying from 150 to 10,000 gm/mm^2. The boundary was oriented at 45° to the compression direction. The stress for grain-boundary sliding and fracture varied markedly with crystal misorientation; high-twist-low-tilt boundaries being much weaker than other misorientations. For a given misorientation there was considerable scatter in the fracture and sliding-stress data which was found to be a result of boundary irregularities (jog content) present in the as-received material or stress-induced during test. Most specimens did not exhibit controlled grain-boundary sliding but rather, would slide uncontrollably to fracture after an incubation period of a few minutes at a critical stress.

REFRACTORY METALS

50303 See Titanium.

50368 See High Strength Alloys.

50420 INVESTIGATION OF ULTRASONIC WELDING OF REFRACTORY METALS AND ALLOYS.
Aeroprojects Inc., West Chester, Pennsylvania. Navy Bureau of Weapons, Bimonthly Progress Report No. 1, November, 1962, Contract No. NOw 63-0125-c
(4 pages, 1 table)

Preliminary specifications for Power-Force Programming (PFP) control circuits and the tentative design for a system have been established. PFP components have been secured, and a 4-kilowatt spot welder has been modified to operate with them. Efforts have been expended in securing an adequate source of refractory metals, and probative meetings have been established with manufacturers relative to material composition and processing techniques.

Columbium

50242 SHEAR STRENGTH PROPERTIES OF REFRACTORY METAL FASTENERS. McDonnell Aircraft Corporation, ASD, Report 9346, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(8 pages, 2 figures, 2 tables)

In order to obtain supplementary data for refractory metals, ultimate-shear-strength tests were conducted in air at room temperature and 1600 F. Testing was performed on five refractory alloys: Cb-10Ti-10W, Cb-10Ti-3Zr, Mo-0.5Ti, Cb-1Zr, Cb-15W-5Mo-1Zr (F48); and seven types of fasteners: solid rivets, explosive rivets, chromium-coated rivets, Huck rivets, Deutsch rivets, DuPont explosive rivets, and solid bolts.

50248 DESIGN DATA STUDY FOR COATED COLUMBIUM ALLOYS. J. D. Gadd, Thompson Ramo Wooldridge Inc., TAPCO, Cleveland, Ohio. Bureau of Naval Weapons, ER-5185, Final Summary Technical Report, January 21, 1963, Contract No. NOw 62-0098-c
(112 pages, 51 figures, 19 tables)

Design-data properties were determined for two protective-coating-columbium-alloy systems involving Pfaudler and TRW oxidation-protective coatings on Fansteel-85 columbium alloy up to temperatures of 2600 F. Prior to the design-data study, preliminary screening oxidation, bend, and prestrain tests were conducted on seven oxidation-protective coatings applied to D-14 and FS-85 columbium alloys. Based on the screening test results, Pfaudler and TRW coatings were selected for the mechanical properties evaluation. The following design properties were determined for uncoated, Pfaudler, and TRW coated 30 mil FS-85 alloy sheet: (a) coating cyclic-oxidation-protective life, (b) tensile properties of uncoated (in vacuum) and coated (in air) sheet, (c) coating deformation tolerance, and (d) stress-rupture properties of coated sheet.

50381 MECHANICAL PROPERTIES OF NIOBIUM-OXYGEN ALLOYS. W. F. Sheely, Journal of Less-Common Metals, Volume 4, No. 6, December, 1962, pp. 487 - 495
(6 references, 9 pages, 5 figures, 5 tables)

Niobium with grain size ranging from 0.1 to 2 mm and with dissolved oxygen contents ranging from 500 to 6,400 ppm twins at -196 C on yielding in compression. Twinning does not occur at -196 C in samples not contaminated with oxygen or in any of the samples at -74 C or at higher temperatures.

Deliberate contamination by oxygen seems to promote twinning at -196 C.

In the temperature range from -196 C to 100 C the effect of grain size on yield strength, either with or without twinning, increases with oxygen content. Larger grained specimens yield at lower stresses than finer grained specimens.

At elevated temperatures, the greatest influence of oxygen on tensile properties is between 300 and 400 C, where it is believed to cause strain-aging. Any effect is lost above about 700 C.

Chromium

50210 See Engineering Steels.

Molybdenum

50213 DETERMINATION OF SILICONIZED COATING THICKNESS IN AND AROUND HOLES AND COUNTER SINKS IN MOLYBDENUM ALLOY (TZM) SHEET. H. W. Jacobson, McDonnell Aircraft Corporation, St. Louis, Missouri. ASD, Report 9344, Final Report, January 10, 1963, Contract No. AF 33(657)-7749
(108 pages, 94 figures, 4 tables)

This report is a dimensional and photographic study of the changes incurred when a pack-cementation silicide coating was applied to molybdenum alloy (TZM) sheet. Dimensional changes due to coating buildup in and around drilled, reamed, and countersunk holes are tabulated.

Photomacro- and photomicrographs graphically illustrate the problem of exfoliation and delamination occurring during machining operations performed on this material.

50242 See Columbium.

50512 CO-REDUCTION AND CONSOLIDATION OF MO-0.5TI-0.1C ALLOY. J. J. Rausch and C. R. Simcoe, Armour Research Foundation, Chicago, Illinois. Bureau of Naval Weapons, ARF-B224-5, Final Report, February 4, 1963, Contract No. NOw 61-0548-c
(28 pages, 12 figures, 3 tables)

Co-reduction of preblended halides by a modified Kroll Process has been investigated as a means of producing prealloyed Mo-Ti-C powders. Processing parameters were varied in an attempt to produce a composition similar to that of commercial Mo-0.5Ti alloy. This was successfully accomplished except for an abnormally high oxygen content. The oxygen present in the material caused compositional variations during subsequent processing and resided as a finely dispersed Mg-Ti-O phase.

The alloys, after sintering, were extremely fine grained and were readily hot and cold workable. A bend-transition temperature below -80 F was determined for one lot of material in the partially recrystallized condition. Tensile properties were similar to those of the commercial alloy at 2000 F; however, the recrystallization temperature was considerably lower.

50514 IMPROVED OXIDATION RESISTANCE OF MOLYBDENUM BY ALLOYING WITH RARE EARTH AND OTHER SELECTED METALS. Colorado School of Mines Research Foundation, Inc., Golden, Colorado. Bureau of Naval Weapons, Interim Report No. 7, February 1, 1963, Contract No. NOw 62-0305-d
(3 pages, 1 table)

The selective oxidation of moly-hafnium alloys at 1.0, 5.6, 15.0, and 25.0 atom per cent hafnium at 1200 C and 1300 C, and at two different partial pressures of oxygen has been extended to 1100 C in order to get a more reliable picture of the effect of temperature upon the diffusion rates of hafnium and of oxygen.

50542 SELECTION OF HIGH-STRENGTH MOLYBDENUM AND TUNGSTEN ALLOYS. R. I. Jaffee, Minutes MAB Refractory Metal Sheet Rolling Panel Alloy Requirements and Selection Group, Washington, D. C., paper presented, November 30, 1962 (6 pages, 1 table)

The Alloy Requirements and Selection Group heard presentations of high-strength molybdenum and tungsten alloys by Climax Molybdenum Company and Sylvania Electric Products Company. Climax presented two candidates which met the ground rules for pilot scale development: Mo-1.25Ti-0.3Zr-0.15C (TZC) and Mo-25W-0.1Zr-0.3C (WZM). Both alloys were produced in billet form by arc casting and extrusion.

Sylvania Electric Products Company has been working on molybdenum and tungsten-base alloys produced by powder-metallurgy processing. None of the alloys has been brought to pilot development scale.

Table 1 summarizes the high-temperature strength of some of the alloys presented.

Tantalum

50558 TANTALUM BASE ALLOY, T-111. Westinghouse Electric Corporation, Blairsville, Pennsylvania. Preliminary Data Revised, January 15, 1963 (6 pages)

T-111 is a new Ta-8W-2Hf alloy exhibiting superior strength at temperatures from 2000-3500 F, yet retaining excellent ductility for formability and weldability by conventional means. It is designed for high-temperature liquid-metal containment, leading edges for hypersonic and re-entry vehicles, components in honeycomb structures, rocket engine components, such as reaction chambers, nozzles and nozzle liners, gas turbine parts and fasteners at elevated temperatures.

T-111 does not rely on strain hardening to achieve optimum high-temperature properties. The alloy can be supplied in either the stress-relieved or recrystallized condition, depending on the requirements of subsequent fabrication and service. T-111 is available in most mill product forms. Composition, physical and mechanical properties, welding, machining, forming, and corrosion of T-111 are given.

Tungsten

50423 See Titanium.

50542 See Molybdenum.

50571 OBSERVATIONS OF PROPERTIES OF SINTERED WROUGHT TUNGSTEN SHEET AT VERY HIGH TEMPERATURES. E. C. Sutherland and W. D. Klopp, Lewis Research Center, Cleveland, Ohio. NASA, D-1310, Technical Note, February 1963 (9 references, 40 pages, 16 figures, 3 tables)

The mechanical properties of tungsten sheet from five typical commercial lots were examined at temperatures from 3650 to 5200 F. The properties varied widely with the material lot as well as with the type of test. The variations at very high temperatures appeared greater than those observed at lower temperatures.

The presence of trace elements appears to affect significantly the properties of tungsten sheet. These impurities exert solid-solution-strengthening effects and grain-growth-inhibition effects, both of which influence the tensile and creep properties at elevated temperatures.

MISCELLANEOUS

50234 PROCEEDINGS OF THE NASA-UNIVERSITY CONFERENCE ON THE SCIENCE AND TECHNOLOGY OF SPACE EXPLORATION - VOLUME 2. National Aeronautics and Space Administration, Washington, D. C. SP-11, Conference held in Chicago, November 1-3, 1962
(numerous references, 532 pages, numerous figures, numerous tables)

The following general areas of space exploration were discussed: chemical rocket propulsion, nuclear propulsion, power for spacecraft, electric propulsion, aerodynamics, gas dynamics, plasma physics and magnetohydrodynamics, laboratory techniques, materials, and structures. During the session on materials the following papers were presented: "Space Environment and Its Effects on Material", by Don D. Davis, Jr., "Non-Metallic Materials for Spacecraft", by George F. Pezdirtz, "Ablation Materials for Atmosphere Entry", by Leonard Roberts, "Flow and Fracture Problems in Aerospace Vehicles", by Richard Kemp, and "High Strength Materials Research", by Hubert B. Probst.

50305 DEVELOPMENT OF STABLE TEMPERATURE CONTROL SURFACES FOR SPACECRAFT. W. F. Carroll, California Institute of Technology, Pasadena, California. NASA, Technical Report No. 32-340, Progress Report No. 1, Contract No. NAS 7-100
(10 references, 17 pages, 12 figures, 3 tables)

Several white paints and non-paint "white" systems were tested for suitability as temperature-control surfaces in space with high-intensity ultraviolet radiation (approximately 10 X solar) in vacuum. The materials and methods of testing are presented in this progress report, which is concluded with a discussion of the measurement results.

50320 RESEARCH ON THE SAMARIUM-TYPE INTERMEDIATE PHASES OF INTRA-RARE-EARTH BINARY SYSTEMS. J. F. Nachman, C. E. Lundin, and G. P. Rauscher, Jr., University of Denver, Denver, Colorado. Office of Naval Research, DRI No. 2080, Technical Report No. 1, January, 1963, Contract No. Nonr-3661(02)
(7 references, 32 pages, 18 figures, 11 tables)

The existence of a samarium-type phase in intra-rare-earth alloys, consisting of a light and a heavy rare earth, has been verified in the La-Gd, La-Y, Ce-Y, and Nd-Y systems. X-ray diffraction and metallographic techniques were employed to establish the composition limits of the single and two-phase regions. Precise lattice parameters and X-ray densities for the alloys were calculated from data obtained with the Debye-Scherrer camera. A hardness survey of the intra-rare-earth alloys is also presented.

50438 EXPERIMENTAL EVALUATION OF THEORETICAL ELASTIC STRESS DISTRIBUTIONS FOR CYLINDER-TO-HEMISPHERE AND CONE-TO-SPHERE JUNCTIONS IN PRESSURIZED SHELL STRUCTURES. W. C. Morgan, and P. T. Bizon, Lewis Research Center, Cleveland, Ohio. NASA TN D-1565, Technical Note, February, 1963 (8 references, 27 pages, 10 figures)

The elastic stress distributions of two shell junctions that have application in space-vehicle design were measured. The junctions were a cylinder with a hemisphere and a cone with a portion of a sphere. These junctions were incorporated in a single type of structure, a cylinder with a toriconical head. Two test structures were used; the principal difference between them was the accuracy of methods used in fabrication.

The investigation was conducted to evaluate previously published analyses for determining stress distributions at these junctions under internal pressure. The data obtained from the tests were compared with theoretical curves determined from these analyses.

The general trends of the data were consistent with the theoretical stress distributions. In the spun structure, the average magnitude of per cent variation of experimental stress from theoretical stress values was 9.2; the other structure, made to more exact specifications, had a variation of 3.8 per cent. The principal source of experimental error appeared to be variation in geometry from the dimensional values assumed for purposes of analysis.

Evaluation of the stress distributions indicated that the half-angle of the cone was not an important parameter. It also was noted that maximum effective stress in this type of structure would be approximately 3.5 per cent higher than the cylinder-membrane effective stress at any ratio of cylinder radius to wall thickness.

50524 See High Strength Alloys.

50525 See High Strength Alloys.

50563 See Engineering Steels.

50564 METHOD FOR MEASURING SONIC DISLOCATION VELOCITIES. J. A. Carlsson, and J. J. Gilman, Brown University, Providence, Rhode Island. Office of Naval Research, Technical Report No. 4, December, 1962, Contract No. Nonr-562(32) (2 references, 7 pages, 5 figures)

The purpose of the present paper is to present a new technique for applying dynamic stresses to elastic-plastic specimens. Outstanding features of the method are its simplicity and the well defined state of stress that it produces. Intensity of the stress and the stress-rate can be varied over a larger range than most other methods allow. Although the method was developed for studying high-speed dislocation motions in crystals, it can readily be adapted to studies of macroscopic plastic flow.

50583 HIGH-VACUUM TECHNIQUES FOR RESEARCH. J. L. Taylor, National Aeronautics and Space Administration, Washington, D. C., December, 1962, NASA SP-26 paper presented at NASA-University Conference on Science & Technology of Space Exploration, Chicago, Illinois, November 1-3, 1962 (15 references, 19 pages, 19 figures, 2 tables)

This paper discusses vacuum; how it is obtained, how it is used in research, and its future.

Coatings

50200 See Magnesium.

50210 See Engineering Steels.

50213 See Molybdenum.

50248 See Columbium.

50216 See Composites.

50234 See Miscellaneous.

50240 See Engineering Steels.

50241 See Stainless Steel.

50242 See Columbium.

50259 THE SATURN S-II STAGE - A STATUS REPORT. D. K. Huzel, North American Aviation, Society of Automotive Engineers, Inc., New York, New York. Paper No. 582B presented at the National Aeronautics and Space Engineering & Manufacturing Meeting, Los Angeles, California, October 8-12, 1962
(7 pages, 5 figures)

Several missions within the Advanced Saturn Program have been outlined for the S-II stage. The primary mission planned for the S-II stage is the manned lunar-orbital rendezvous maneuver (LOR).

Much pertinent information on this mission has been published in the trade magazines and elsewhere. It is the purpose of this report to describe a few more detailed aspects and the amount of work accomplished to date on the second Saturn stage.

50260 LAUNCH VEHICLE RECOVERY SYSTEM REQUIREMENTS. R. M. Barraza, George C. Marshall Space Flight Center, NASA, Greenbelt, Maryland. Society of Automotive Engineers, Inc., New York, New York. Paper No. 590D presented at the National Aerospace Engineering & Manufacturing Meeting, Los Angeles, California, October 8-12, 1962
(6 pages, 10 figures, 1 table)

Primary considerations in the design and development of a recovery system applicable to present expendable first stage launch vehicles in the Saturn class are discussed. The three critical phases of flight that define characteristics of a recovery system are broken down into: (1) conditions and requirements between stage separation to re-entry; (2) re-entry; (3) terminal descent and landing. The degree of criticalness is primarily influenced by the conditions at stage cutoff and separation.

Vehicle considerations that must be investigated in establishing the requirements of a recovery system are presented. In addition, two programs initiated at George C. Marshall Space Flight Center, NASA, Huntsville, to substantiate a recovery program for launch vehicles are reviewed. They are the H-1 engine salt-water-immersion tests and the booster retrieval exercises at sea.

50261 DESTINATION-MOON - THE DESIGN AND FABRICATION OF THE CENTAUR NOSE CONE. B. E. Chitwood, General Dynamics Corporation, Fort Worth, Texas. Society of Automotive Engineers, Inc., New York, New York. Paper No. 579A presented at the National Aerospace Engineering & Manufacturing Meeting, Los Angeles, California, October 8-12, 1962
(4 pages, 5 figures)

50261 (Continued)

This article describes the NASA's Centaur nose cone. It discusses its purpose, the loads and temperatures to which it will be subjected, the materials from which it was fabricated, and some of the design and fabrication problems involved. Testing of the raw materials and the finished part is also discussed.

50264 A LARGE DIAMETER X-RAY SENSITIVE CAMERA TUBE. R. Rutherford, Jr., Columbia Broadcasting System, Inc., Stamford, Connecticut. WAL TR 142/68, Final Report, October 1, 1962, Contract No. DA-19-020-ORD-5515 (22 pages, 9 figures)

The design and fabrication of several developmental large-diameter (nine-inch) X-ray-sensitive camera tubes of the photoconductive-selenium-surface type is described with preliminary operational results. Aluminum and beryllium window tubes were successfully made using an epoxy cold-seal technique with continuously operating gettering pumps.

50278 FEASIBILITY INVESTIGATION AND DEVELOPMENT OF 2000°C RESISTANCE TEMPERATURE SENSOR. J. T. Chambers, Advanced Technology Laboratories, A Division of American-Standard, Mountain View, California. ASD TDR 62-417, Final Report, December, 1962, Contract No. AF 33(616)-8263 (10 references, 50 pages, 18 figures, 12 tables)

A program was undertaken to determine the feasibility of an iridium resistance thermometer, mounted in yttrium oxide, for measuring temperatures in solids to 2000 C in an oxidizing environment. The sensor includes a flat grid of 10 inches of 3-mil iridium wire with 10-mil iridium leads, cast in yttrium oxide under pressure and consolidated by high-temperature sintering. The resistance-temperature curve of unencapsuled iridium wire was established experimentally. It is concluded that the resistance thermometer is feasible to at least 1400 C. It is probable that the range can be extended to 2000 C by improving the purity of the oxides used.

50343 See Engineering Steels.

50345 QUALITY CONTROL OF HIGH TEMPERATURE SOLID ROCKET CONTROL COMPONENTS. R. L. Ahearn, Martin-Marietta Corporation, Orlando, Florida. Preprint of Paper No. 70, presented at the 4th Pacific Area National Meeting of the American Society for Testing and Materials, Philadelphia, Pennsylvania, October 1-5, 1962
(11 pages, 15 figures)

This paper describes some of the problems encountered in establishing quality requirements for jet vanes used in solid-propellant rockets. The processing techniques used to assure a reliable product are also presented.

50523 See Special Refractories.

50563 See Engineering Steels.

50584 RESEARCH, DESIGN CONSIDERATIONS, AND TECHNOLOGICAL PROBLEMS OF STRUCTURES FOR LAUNCH VEHICLES. H. L. Runyan and R. W. Leonard, National Aeronautics and Space Administration, Washington, D. C., December, 1962, NASA SP-28, paper presented at NASA-University Conference on Science & Technology of Space Exploration, Chicago, Illinois, November 1-3, 1962 (15 references, 12 pages, 17 figures, 1 table)

Some of the branches of the technology needed in the reliable and efficient design of launch-vehicle structures are discussed. Included are shell buckling, stress analysis, panel flutter, noise, vehicle response to horizontal winds, vibrations, dynamic modeling, and the study of new configuration concepts as complete systems. Examples are shown to indicate the state of the art, and numerous problems which require solution are indicated.

50585 RESEARCH, DESIGN CONSIDERATIONS, AND TECHNOLOGICAL PROBLEMS OF STRUCTURES FOR WINGED AEROSPACE VEHICLES. E. E. Mathauser, National Aeronautics and Space Administration, Washington, D. C., December, 1962, NASA SP-28, paper presented at NASA-University Conference on Science & Technology of Space Exploration, Chicago, Illinois, November 1-3, 1962 (20 references, 12 pages, 19 figures)

Research, design considerations, and technological problems of structures for winged aerospace vehicles are discussed, and areas in need of further research are explored. The presentation includes structural approaches required to cope with the high nonuniform temperatures and the influence of such factors as flutter, acoustic fatigue, and materials selection on the structural design.

50586 RESEARCH, DESIGN CONSIDERATIONS, AND TECHNOLOGICAL PROBLEMS OF STRUCTURES FOR PLANETARY ENTRY VEHICLES. R. A. Anderson, National Aeronautics and Space Administration, Washington, D. C., December, 1962, NASA SP-28, paper presented at NASA-University Conference on Science & Technology of Space Exploration, Chicago, Illinois, November 1-3, 1962 (25 references, 10 pages, 14 figures)

The technology for structural design of manned and unmanned planetary-entry vehicles is reviewed. Emphasis is placed on the important features of these vehicles—the thermal shield and the landing system. Basic structural and material concepts are discussed in the light of applicable environmental conditions, and areas for further research are suggested.

Composites

50215 See Nickel Base.

50216 ELASTOMERIC SEALS AND MATERIALS AT CRYOGENIC TEMPERATURES. D. H. Weitzel, R. F. Robbins, P. R. Ludtke, Y. Chori, and R. N. Herring, National Bureau of Standards, Cryogenic Engineering Laboratory, Boulder, Colorado. ASD TDR 62-31, Contract No. AF 33(616)-61-04
(18 references, 68 pages, 27 figures, 8 tables)

This research deals with investigations of elastomeric polymers, with particular emphasis on their usefulness as seals at cryogenic temperatures. O-ring seals utilizing various flange configurations have been extensively evaluated at temperatures between 76 and 300 K. A supporting program of property measurements includes thermal expansivities, shear and compression modulus, differential thermal analysis, and the force-temperature effects of prestressed elastomers.

50239 See Stainless Steel.

50250 HANDBOOK OF DESIGN DATA ON ELASTOMERIC MATERIALS USED IN AEROSPACE SYSTEMS. A. G. Pickett and M. M. Lemcoe, Southwest Research Institute, San Antonio, Texas. ASD TR 61-234, Final Report, January, 1962, Contract No. AF 33(616)-7093
(233 references, 222 pages, numerous figures and tables)

The objective of this handbook is to provide aerospace weapons-system design engineers with useful data on the materials properties of elastomers. The sources of this information are Department of Defense research reports and the technical literature of engineering design and elastomer technology. The elastomeric materials for which data are presented are compounds of high polymers currently available in the United States. The properties considered are original mechanical and physical properties and the changes in these properties that result from aging and exposure to environments of aerospace weapons systems. Elastomer compounding is only briefly treated in this handbook because it is intended for use by structural and mechanical engineers rather than by rubber chemists and technologists. Elastomer-part design methods are not reviewed in this handbook because they are the subjects of other Department of Defense reports which this handbook is intended to complement. A selected bibliography of technical literature on elastomers and elastomeric parts is included to aid the handbook user who needs further information on these topics.

50343 See Engineering Steels.

50368 See High Strength Alloys.

50434 DEVELOPMENT OF IMPROVED HIGH-STRENGTH PREIMPREGNATED MATERIALS FOR FILAMENT WINDING. Ira Petker, S. Brelant, and M. Segimoto, Aerojet General Corporation, Azusa, California. Bureau of Naval Weapons, Report No. 2440, Summary Report, December, 1962, Contract No. NOw 61-0642-c (FBM)
(16 pages, 5 figures, 6 tables)

Data are included for six experimental lots of roving, both dry and preimpregnated. Two experimental lots of roving are currently under investigation in the laboratory. Completion of the evaluation of these eight lots of roving will complete the Phase I portion of the investigation. A description is given of the redirected Phase II of the program, which will be devoted entirely to a study of the preimpregnation process.

50544 See Cobalt Base.

50577 REPORT ON SPECIAL MEETING TO DISCUSS NONDESTRUCTIVE TESTS FOR FILAMENT WOUND FIBERGLASS MOTOR CASES. S. D. Hart, Aerojet-General Corporation, Sacramento, California. United States Naval Research Laboratory, TM 221, Technical Memorandum, January 24-25, 1963
(7 pages)

A summary of the meeting of participants in the Polaris project to discuss the testing and inspection of fiberglass motor cases is presented.